

An Amateur Wireless Magazine

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**The American Radio
Relay League**



FOR THE MONTH OF MARCH
NINETEEN HUNDRED AND SIXTEEN

ZENNECK'S Wireless Telegraphy

"The Book You Have Been Looking For"

By J. ZENNECK, Professor of Experimental Physics at the "Technische Hochschule," Munich. Translated by A. E. SEELIG, Mem. A. I. E. E., formerly General Manager, Atlantic Communication Co. 428 pages, 6x9, 461 illustrations, 13 tables, \$4.00 net, postpaid.

CHAPTER HEADINGS

I. The Natural Oscillations of Condenser Circuits. II. Open Oscillators. III. The High Frequency Alternating-Current Circuit. IV. Coupled Circuits. V. Resonance Curves. VI. The Antenna. VII. Transmitters of Damped Oscillations. VIII. High Frequency Machines for Undamped Oscillations. IX. Undamped Oscillations by the Arc Method. X. Propagation of the Waves Over the Earth's Surface. XI. Detectors. XII. Receivers. XIII. Directive Telegraphy. XIV. Wireless Telephony. Development of Wireless Telegraphy During the Years 1909-1912. Tables—22 Pages of Useful Tables. Bibliography and Notes on Theory. Index.

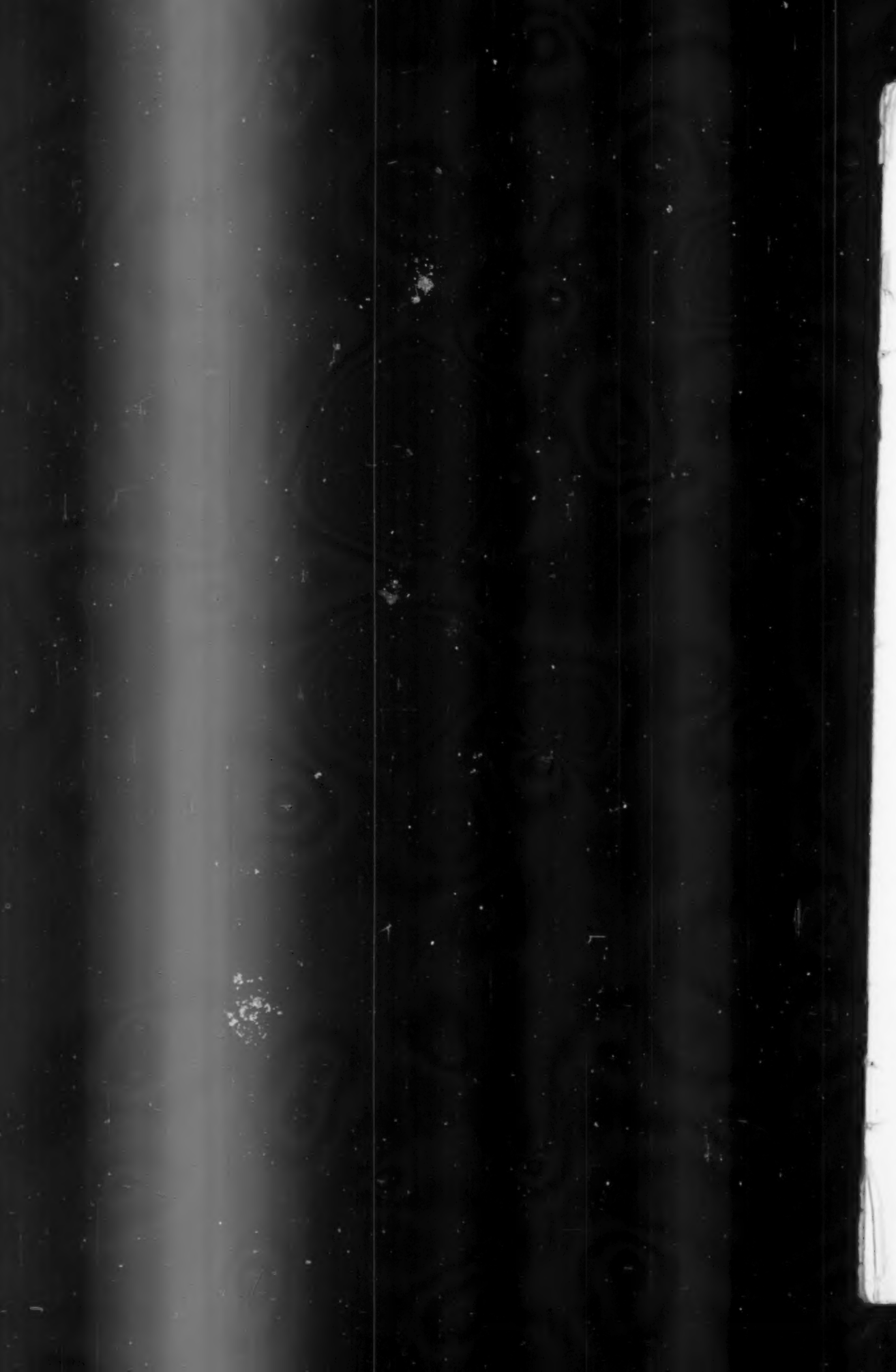


EVERY amateur operator and every student of wireless owes a debt to Mr. Seelig who has translated Dr. Zenneck's "Lehrbuch der drahtlosen Telegraphie." This book has been a standard in Germany and now it is brought to America and translated for us. The book carefully covers all phases of wireless telegraphy, from the fundamental principles to finished commercial apparatus. In the technical part you will find explanations which clear up every hazy point. Among the interesting features are the illustrations and photographs of dampened sparks. You can find out all about decrement. You see exactly how the ether waves travel. Once you read the book, you wonder how you did without it.

This text is of such great importance to the LEAGUE members that the Secretary has made arrangements to supply the book. Write for it today. There was never a book worth more. You need it: send to the Secretary.

The American Radio Relay League, Inc.
Hartford, Connecticut

ALWAYS MENTION "QST" WHEN WRITING TO ADVERTISERS





QST



March, 1916

Number 4

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QST is published by and at the expense of Hiram Percy Maxim and Clarence D. Tuska. Its object is to help maintain the organization of the American Radio Relay League and to keep the amateur wireless operators of the country in constant touch with one another. Every amateur will help himself and help his fellows by sending in \$1 for a 12 months' subscription.

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All these firms have placed advertisements in our "QST" the number of times stated. This list nearly covers all desirable wireless concerns. There are a few

others but they haven't come forward to advertise as yet. Of course advertising is one of the things that keeps "QST" going. These advertisers want results—they don't advertise merely to support "QST." They advertise for results. They get these results if you will buy of them and ALWAYS MENTION "QST" WHEN YOU WRITE TO THEM.

Let everyone do his share. Let the backward advertisers in wireless supplies come forward—do their share of the advertising and GET THEIR SHARE OF THE RESULTS. Let those who have advertised once or twice come forward again. Let the subscribers to their share—purchase goods from our advertisers. If everyone does his share, "QST" will very soon be the kind of a magazine we amateurs have wanted "THE BEST WIRELESS MAGAZINE IN THE ENGLISH LANGUAGE."

THE PUBLISHERS OF "QST."

IMPORTANT NOTICE!

This was a very short month; the printer became rushed and in trying to get the magazine out ON TIME made two errors. We trust the readers will be patient with us, as we hope to eliminate these errors hereafter.

Page 55, 2nd column, 2nd paragraph, should follow 1st paragraph, 2nd column on page 54.

Heading on page 59, "Interesting Meeting of the Radio Club of America" should be omitted.

March Radio Relay Bulletin

PRACTICAL POINTERS ON THE AUDION

By A. B. Cole, E. E.

Sales Manager — De Forest Radio Tel. & Tel. Co.

THE purpose of the present article is not to sell Audions, but to assist those who use the justly famous Audion to obtain the best results, with a view to promoting the best interests of the amateur experimenter.

So much has been written without authority of the patentees which is partially incorrect or serves to cause the experimenter to aspire to fields which cannot be achieved in a practical fashion by him and so many false directions have been given for making apparatus from the regular Audion Detector for which it is not adapted, that it seems only right to set the experimenter on the proper track, showing what can be done and how to do it, pointing out the fallacies in statements made by unauthorized parties.

Be it known, first of all, that the writer is one of the pioneer amateurs, whose experimenting in wireless matters dates from 1904, and although engaged in commercial as well as amateur work, is still an amateur at heart and thoroughly in sympathy with amateur work, not as some whose first training was commercial and who look down on the amateurs as a small detail from whom revenues must be extracted because their superiors wish it, but strictly as an amateur of many years' experience, and, therefore, qualified to assist those working in this field in an intelligent way.

In 1908, I used one of the very early types of Audion, so that it is not very new to me. As Sales Manager for the manufacturers, I have investigated and corrected probably every kind of trouble which can be had with the Audion. Yet, I am frank to admit that I do not know it all, being thereby different from outsiders who can write books on it from their limited experience with a few bulbs.

Now, you should know that very seldom are two Audion bulbs exactly alike in their characteristics, but not much variation is permitted because too much in the way of instructions would have to be furnished the user, and so those not coming within the limits are discarded or furnished only to those of considerable experience.

The Audion is a peculiar instrument in many ways. If used in connection with the proper circuits and accessories, it is the most sensitive and reliable detector ever invented, which fact cannot be denied. If, for example, the "grid condenser" is of the wrong capacity or inefficient, or the wiring of the circuits is not correct or the insulation of the wires of these circuits poor, or if they are placed too close together, trouble is very likely to occur which is difficult to locate and is invariably charged to the "bulb." It is remarkable how easy it is to have trouble if the circuits and parts of the

detector as a whole are not correct, and this is one of the main reasons why the bulbs are not furnished separately and why all guarantees are immediately dissolved if an Audion bulb is used otherwise than in the Audion Detector made for it. One of the best amateurs in the country who has used the Audion for some time sent in his bulb on request, as he could not obtain good results. Investigation showed that he had taken the detector apart and assembled it in a complete receiving cabinet and after much loss of time, it was discovered that the "grid condenser" did not suit his taste and so he built another which consumed internally in losses nearly all of the incoming energy. The bulb, used in a regular Audion Detector, was excellent. This is only one representative case of many.



A. B. Cole, E. E.

AUDION BULBS

It has often been asked, "How is an X grade Audion Bulb made, and what makes it different from the S grade?" Also, "How are the bulbs tested?" These are questions of interest to all users, and rightfully so.

The process of testing Audion Bulbs is one of the most careful and expensive tests in the entire electrical industry. A bulb used in the proper detector may give extremely loud signals from stations twenty or thirty miles away, and yet not be really sensitive to weak signals from great distances, or it may give much weaker response to nearby stations than a crystal detector and still be extremely sensitive to weak signals over long distances.

Theoretical methods of testing are, therefore, of no value. The only practical method is to compare with a standard, under actual working conditions, receiving weak signals. The standard is set by comparison with the best crystal detector. The unknown bulb is connected in circuit on a double detector, and the oscillations are tuned from one bulb to the other, reducing coupling and making the necessary changes in capacity to counterbalance change of mutual inductance, until the signals can be heard on one bulb and not on the other. Testing by throwing the circuits out of tune is not satisfactory because the Audion is a potentially operated detector.

If the unknown bulb is equal to or better than the standard, it is passed, but otherwise discarded. If it is sufficiently more sensitive, it is passed as the "X" or extra sensitive grade. There may be one X grade bulb in 100 or there may be twenty—no one can tell. There may be ten S grade bulbs in 100 or there may be fifty. The Audion bulb looks simple, but is one of the most difficult instruments to make ever invented.

The testing is done by expert, commercially licensed operators, of years of experience, and thoroughly familiar with the Audion. The employment of a beginner, or one only experienced in operating, for the work, would be fatal. The tuning apparatus is regular amateur equipment, not the specially designed and necessarily more efficient apparatus made for the Audion.

AUDION TROUBLES AND HOW TO CORRECT THEM

(1) The most common cause of trouble is due to exhaustion of one or more of the "B" high voltage dry flashlight batteries. These batteries are at best unreliable, from their very nature. If only one becomes exhausted until it registers $3\frac{1}{2}$ volts or less on a voltmeter, the efficiency of the entire

receiving set is remarkably decreased. The great difficulty is to convince the operator of the necessity of testing every battery often with a voltmeter. As soon as one or more shows $3\frac{1}{2}$ volts or less, it must be replaced, and all connections must be soldered. If not replaced at once, the operator always brings up the intensity of the filament, and, of course, burns it out before long—then says the bulb was defective.

(2) The next most common cause of trouble occurs when the operator replaces one or more cells, and connects them backwards with respect to the others, connecting the carbon to the carbon of the next battery.

Then again, when the operator replaces the entire set of batteries, he often connects the carbon to the filament of the bulb. The detector cannot operate unless the negative or zinc is connected to the filament. And again, the bulb was all right, but now has lost its sensitive qualities!

(3) The third cause of complaint, due entirely to the operator, is the fact that, "The old bulb was very good, and the new one cannot compare with it." This is because of either of the above causes, or he does not try reversing the connections from the "A" or lighting battery. Some bulbs will not operate at all unless this is done to find which way is best.

(4) Then, some operators use the Audion in a cold place. Consider the surface of glass of the bulb, and realize that the very small quantity of gas in it must necessarily be affected by change of temperature. The Audion works best when the temperature of the room is 60 degrees or higher.

(5) Then comes the complaint from a beginner who says, "The Audion brings in 500 meters and amateur stations, better than any other detector I have ever tried, but Arlington on his 2500 meter wave is much stronger with a crystal detector." This is easy to explain. The Audion is selective to some extent as to spark frequency, but positively is not selective as to wave length. It is exactly as sensitive at 3000 meters as at 200. If you will consider the proportions of an amateur tuner, you will realize that it is most efficient from 200 to 1500 meters. They are all built in this way. When a loading coil is used in the primary circuit, the efficiency of the primary is decreased, although its period is increased.

The secondary, if one is used, is seldom loaded. A variable condenser will help to some extent, but unless the tuner can receive with high efficiency the long waves, it is impossible to operate the Audion to full

efficiency. A crystal operates whether exactly in tune or not, but the Audion, being potentially operated, must have efficient tuning equipment if its advantages can be realized to the fullest extent.

(6) Do not try to use a fixed condenser in series with an Audion Detector. Every one of these instruments has a special mica condenser within it, properly connected and built, and I do not believe it can be improved upon. Unauthorized parties give all kinds of advice, but it seems only reasonable that the manufacturers should know and install what is right.

A variable condenser across the tuner posts is of great value in obtaining the exact point of resonance, but nothing in the way of a condenser should be used in series to reduce efficiency.

(7) Then there is the operator who turns off his lighting battery and neglects to cut in more resistance by means of the rheostat. The battery recuperates while standing and when turned on again, often burns out the filament or seriously injures it. Remember that a sensitive and delicate instrument requires a little thought and care.

(8) The use of a magnet near an Audion Bulb sometimes increases the intensity of signals, but we have seen filaments literally bent out of place due to this, and a common result is short life of the bulb. (Note below under Fallacies (3).

(9) Remember that all regular Audion Bulbs have $3\frac{1}{2}$ volt filaments and never connect more than 6 volts to it. The rheostat will handle effectively 6 volts, but no more should be employed.

ADJUSTMENT OF THE AUDION

(1) Nearly every Audion bulb has two critical points. One is found when the "A" and "B" batteries are adjusted to certain points. The other is found, generally with the "B" battery adjusted to a higher voltage than above and the filament operating at less brilliancy with the lighting battery connections reversed. Some bulbs have only one critical point, within the limits of the usual "B" battery voltage, and so it is important to TRY REVERSING THE LIGHTING BATTERY connections to the detector.

An Audion should always be operated with the higher "B" voltage and lower filament intensity to obtain greatest life.

(2) The "critical point" is reached at certain adjustments of both the "A" and "B" batteries. At this point, a hissing sound is generally heard in the receivers. If this is present, the filament brilliancy should be decreased until the sound is just

audible or is just below the audible point.

When strong signals are received, they may be much increased in intensity by increasing both the "B" battery voltage and the filament brilliancy, but while greater volume of sound is obtained, the bulb is not in its most sensitive condition at this adjustment. With some excellent bulbs, no hissing sound can be heard at any adjustment, or it may appear, but be very weak.

(3) The "Blue Glow" appearing at certain adjustments of the "B" battery in the old style tantalum filament bulbs is often not found at all in the tungsten and Hudson filament types, and is not necessarily an indication of sensitive qualities.

FALLACIES

(1) **Making an Amplifier from a Detector.** There are several reasons why this cannot be done with even fair efficiency. If the necessary three winding transformer is not exactly made and balanced, the results are poor. The Audion Amplifier Bulb is entirely different from the Audion Detector Bulb in construction and vacuum.

The result of trying to make an amplifier from a detector is only a makeshift in which the efficiency is so low as to make it an expense out of proportion to the benefits obtained.

The Detector bulbs cannot last long enough to make it worth while, and the efficiency is very low.

(2) **Receiving Continuous or Undamped Waves.** Regular Audion Detector Bulbs are not adapted for the reception of continuous waves, because the vacuum is not correct for the purpose and because the filaments must be operated at such a high intensity that they give very short service, making them unnecessarily expensive.

Then, their use in this way causes the vacuum to gradually increase until 75 to 150 volts are required for the "B" circuit.

(3) **"Amplifying" Circuits.** This is the same old story, begun with the creation of the world, of obtaining something for nothing.

If you will think, you will realize that if you pass through an Audion Bulb or any other apparatus, two or three times as much energy as it is designed to carry, the result will be a short life. This appears in "amplifying" circuits in operation of the filament at excessive brilliancy and in rapid deterioration of the filament from carrying abnormal power. The vacuum increases to an extremely high value in most cases.

The final result is expense for renewal bulbs far out of proportion to results obtained and general dissatisfaction—not due to any fault of the manufacturer, because

the instruments and bulbs are sold and licensed for only one purpose, but because the operator is looking for "something for nothing," which is impossible in the long run.

There are many operators of experience with the Audion who know of all the above points, and many more who do not, and these suggestions, the result of long and active experience of one who has corrected more Audion troubles than perhaps any other one individual, should be given that close attention and careful consideration which they deserve, that the very best of results may be obtained and the longest possible ranges covered.

BLUE DISCHARGE OF GLOW

This appears in some Audion Bulbs and not in others. If allowed to persist, the vacuum automatically increases. For this reason the glow should not be allowed to appear and certainly not to continue, as the vacuum may rise to a very high value, requiring very high voltage in the "B" battery. Many amateurs cannot seem to comprehend the value of instructions of this kind, and if they ruin bulbs in this way, always claim that the bulb "was defective," although it is their own negligence which caused the condition.

A super-sensitive detector like the Audion should be handled and used with reasonable care and intelligence. It is not "fool-proof."

ADJUSTMENT

One of the most essential points very seldom appreciated or even known by most operators is the fact that a very fine regulation of the "B" or high voltage battery potential is extremely important in securing utmost efficiency with the Audion. A difference of one volt may make a difference in range of as much as 25 per cent.

The amateur types of Audion Detector manufactured until 1916 have a switch adjustment for this high voltage, providing at each step a difference of three to four volts. The Audion Bulbs were, of course, and still are tested on this type of instru-

ment, so that they may operate properly with same.

One kind of "trouble" is due to the fact that after an Audion Bulb has been used for a time, the vacuum changes slightly, so that the correct voltage required becomes slightly different in value.

Now, it can be readily understood that the operator will have difficulty in obtaining best results when this occurs, because with the switch on one point, the voltage is too low, and on the next higher point, it is too high, and the hissing sound in the telephone receivers may drown out the incoming signals.

The purpose of replacing the "step by step" switch by a potentiometer, which has been done in the new instruments, is to overcome this difficulty and provide any desired voltage within the limits of the battery.

For the benefit of the large number of operators whose Audion Detectors are provided with "step by step" high voltage control switches, the following is recommended on account of the difficulties certain to be encountered, even if the potentiometers were furnished them, in installing same in their instruments.

If a small box is made, large enough to hold one 3 cell flashlight battery, and a switch is mounted on the box, and arranged to cut in one cell at a time, and this device is connected in series with the telephone receivers, and the receiver binding posts on the detector, a very satisfactory adjustment will be provided, enabling the operator to accomplish excellent results with bulbs otherwise considered less sensitive than standard. Of course, this extra battery must be connected in circuit in the proper direction, so that it acts with and not against the regular high voltage batteries of the detector. The proper direction can be readily determined by trial.

This arrangement is thoroughly recommended to every user of an Audion instrument. It is certain to produce results far superior to any ever previously obtained.



The RJ6
Receiving Set
Mfd. by
The De Forest
Radio Tel.
& Tel. Co.

PRACTICAL RELAYING

By Hiram Percy Maxim.

(Continued from February Number.)

IN the February QST, the writer covered broadly a plan for establishing six main Trunk Lines to cover the country. He did not intend in this plan to present a final arrangement, because it did not seem possible from the information at hand to lay out the best points. It seems, however, that the scheme has caught on, if the numbers of letters received from amateur station owners in various parts of the country mean anything. For this reason, the Trunk Lines A, B, C, D, E and F will be assumed as good enough to start with.

The next step to take is to establish local headquarters for each Trunk Line, and to turn over to these headquarters the work of organizing each Trunk Line. In order to intelligently decide upon these different local Headquarters, several things must be given consideration. For example, it would seem that a city forming a junction point for two or even three Trunk Lines, should be Headquarters, because a test message could be started simultaneously from this point, and go out over the several Trunk Lines. Take Chicago as an illustration. Chicago is approximately the central point on Trunk Line A, and it is the starting point for Trunk Line E. A test message starting from Chicago could go west to Seattle, the end of Trunk Line A, east to Portland, Maine, the other end and southwest to Los Angeles the end of Trunk Line E. One job done at Chicago, would thus cover the entire width of the country at the north and also cover a line down the Mississippi to the Gulf and across the southern border to the Coast.

Philadelphia or some point in New Jersey would likewise be a good location to act as Headquarters for the entire eastern section of the country. One test message sent out from here would be carried north-east through New York, Connecticut and Massachusetts, south through the Atlantic States to Jacksonville, Florida, and southwest on Trunk Line D through Pennsylvania, Ohio, Kentucky, Tennessee, Alabama and Mississippi, to New Orleans, La.

These two Headquarters would therefore cover the whole of Trunk Lines A, E, C and D. This leaves only , running west from St. Louis, and F, running north and south from Vancouver to San Diego, on the Pacific Coast. San Francisco is the natural location for the Headquarters for both these lines. One message sent out would run north to Vancouver, south to San Diego

and east to St. Louis.

Thus it seems plain that three cities, Chicago, San Francisco and Philadelphia, or some point between this city and New York, would be all the District Headquarters necessary to carry on a practical system of test traffic which would cover the entire country, entering almost every single state in the Union.

The delicate question of selecting the most suitable station for these Headquarters then arises. Several details must be taken into account in selecting these headquarters. First, there is the necessity for systematic handling of the job. Some people are so constituted that they naturally handle a piece of work in a systematic manner, and records are simple and always kept. Other people entirely lack anything approaching order and system and if one of these should be a District Headquarters, things would go haphazard, hit and miss, and interest would quickly die out on all of the lines which they had charge of.

Another requisite for these district headquarters is the facility for writing letters and looking after the stations which wrote to them. Some amateurs who are in business have letter writing facilities of an office and it is very little work to get off half a dozen letters once in a while. A station owner so situated that letter writing was convenient and easy would be a better Headquarters than one who had not these facilities, other things being equal.

Another requisite, and an important one, as we all know, is the ability to always be on the job at the time specified, or never fail to have some one else if he cannot be there himself. This failure to keep regular hours is the greatest fault we amateurs have, and is the great big factor which limits our radio relaying work. Tom is never on when Dick and Harry are on, and Dick seems to make a point of going to the movies when Tom and Harry most need him. Harry invariably reserves his off night for the time when Tom and Dick depend upon him being at his instruments. In handling test and regular messages, this point must be most carefully considered, and a Headquarters must be selected who can either be on regularly or have other stations who will act for him when he is absent. The nights when the through Trunk Line work is to be done, should not be too often. Three nights a week would probably be impractical and the writer believes that one night a week would be better than

two, unless the relay stations on a given Trunk Line were sure that they could be at their instruments more frequently.

The hour at which the test work was to be done is an important element. QRM has to be considered and the fact that there is a wide difference in time between the Atlantic Coast states and the Pacific Coast states must have weight. NAA sends time at 10:00 p. m. eastern time, which is 9:00 p. m. central time, 8:00 p. m. western time, and 7:00 p. m. coast time. A great many amateurs want to use these signals for various purposes, including testing of their receiving instruments, so that by no possibility must these signals be jammed. The little boy with the spark coil and the dry cells is to be considered early in the evening, and he is notorious for his ability to QRM anything when he is just across the street. It seems therefore, that an hour like 10:30 or 11:00 p. m. would stand more chance of being successful than any other hour. The movies are out by this time, which is a factor we can by no means overlook, and it is not so late that it would kill us to stay up one or even two nights in a week. This matter however, is one for each Trunk Line to settle for itself.

In the matter of lapping over from one time district into another, such as from Eastern Time to Central Time, it would seem that this would have to be delayed at the point where the lap occurred. For example, a message received at Buffalo, the limit of Eastern Time, could be held one hour until Cleveland time came around. Coming the other way, Buffalo would have to understand that things would be one hour later coming from Cleveland than usual. The other alternative is for the east to take a very late hour, say Midnight, and the west to put up with an early hour, say eight o'clock on the coast. This would have the advantage of having us all at our instruments at the same hour all over the entire country. With things well managed, and working right, we could probably handle a message in Chicago through to Portland, Maine and receive back the QSL in fifteen or twenty minutes. In the case of those of us having especially good aerials and ground connections, and who know how to tune, we probably would make many very remarkable and extremely interesting long distance records. It would not be at all

unusual for the man in Maine to hear Ann Arbor, Mich., nor the man in Little Rock, Arkansas to hear Chicago Headquarters when he started out his test msg. From the records which have already been printed in QST, all this and even more would not be unusual.

All things considered, the writer would be personally in favor of the uniform listening in hour all over the country, because he believes the sacrifice of sitting up late in the east would be more than rapid by knowing that every one else throughout the country was at his instruments at that exact moment. This, however, is left to district headquarters, as is proper, and as every other detail of management should also be.

Another important matter is the form a test message should take. For our amateur purposes, we should send out an unknown pass word so as to check up who really got it, and the returning receipt, or as we call it, the QSL, should bear the call letters of every station who received and relayed it. When the QSL is received back to district headquarters, a record should be kept of just how far it got before it had to be returned on account of not being able to get farther. With this information, district headquarters would know just where the blame should be placed and by mail, he could find out if it could be corrected and if so, how.

A thing which would help, would be to publish in QST, every month, the records of the work of each Trunk Line. Then, the League could offer a prize each month to the headquarters who made the most credible showing, just as the different sections on a railroad are given regular prizes for the best showing section on the road.

In closing, the writer wants to put in his plea for help on the matter of selecting District Headquarters. We cannot do this at Headquarters, because we do not know enough. The local stations in or near Chicago or Philadelphia, or San Francisco know who the best station is for District Headquarters, all things considered. Therefore, a vote is wanted from each of these three different places, said vote to be sent in to main Headquarters at Hartford, and only those who know something about the station voted for to cast a vote.

NORRISTOWN RADIO ASSOCIATION HOLDS MEETING

At a meeting of the Norristown Radio Ass'n held on January third the following members were elected to office for a period of six months: Randolph Roland, Pres., Harold Gresh, Vice Pres., Wilbur Heyser,

Treas., and Donald Walker, Sec. The organization would be pleased to hear from similar associations and request that all mail be addressed to Donald Walker, 552 Kohn St., Norristown, Pa.

THOUGHTS OF THE GOOD OLD PALMY DAYS

By Lloyd Manuel
A. I. R. E. AND MEMBER OF
THE AMERICAN RADIO RELAY
LEAGUE

RADIO buglets—lend me your ears. When I was fourteen years old I started in on the wireless game, and am still playing. The first thing that wireless did for me was to permit me to communicate with an otherwise inaccessible place; the second thing that it did was to get me kicked out of school—my mind refused to follow such commonplace stuff as “puella haben rosa” when it was teeming all the time with C equals E over R.

I wanted to establish communication with a fellow but as I had to cross a trolley to do this—the wire-chief said, “Nix.” So we had to dope it out some other way.

I went to the free library and obtained a book telling of Marconi's early experiments. This book told of the necessary parts, and instruments not being obtainable, I, perforce, had to construct them. When I couldn't make, I begged, borrowed or stole.

The first thing that I obtained was an air-rifle. This required considerable “junking.” You may say that an air-rifle is not an actual necessity in a radio-station—but wait a bit, me fren'. I knew a fellow who had an old Western Union relay, so I hied myself to him, gun over shoulder; tacked a card to a fence and shot at it. My friend thought that he could trim me shooting—so he took a shot, and lo, and behold, he plugged the card right off the reel. This gratified him so much that he was going to buy a gun right away. It was then that I got in my dirty work. I obtained the relay, and ran quickly away, fearing that he might change his mind.

The next thing necessary was a coherer. 'Twas then that I bent my well moulded head in an effort to parallel the culmination of Marconi's efforts. Here is how I made my first coherer. Nothing like it has ever been patented—therefore this may be copied and sold at random. (Boston papers please copy.) I took a small bottle—broke off the neck, made two corks fit into this “tube” and covered them with tin foil. Then I went junking again. After obtaining fifteen cents, I very sparingly filed silver and nickle filings from the respective pieces. After connecting two wires to the tin foil plugs, and placing “mixture” between the plugs—I had completed the coherer. The next thing to do was to get a decoherer. This was a simple matter—I stole the door

bell. This was a good arrangement as the peddlers did not bother mother then—but I'm afraid that the dear old lady went without spiritual advice a little longer than she should have.

My first “mast” was also stolen property. It was a clothes pole nailed on the wood-house. The first antenna was hay wire. With this apparatus, I listened for one week. Finally I did imagine that I was getting signals but I am not sure now whether I had a right to imagine. With the advent of the Massey coherer, however, I got things going pretty well—and received quite a few ships as well as the naval station in Newport, R. I.

As I was the only amateur in town in those days, my parents were beginning to regard me as a prodigy. This opinion was never shared by my brother Jim, however. He thought that my head was a convention hall for hallucinations. He slept with me, poor soul, and many a time o' nights he would nudge me, tell me to shove over or he'd punch me—I was dreaming wireless and he said that I was practicing code on his shins.

Soon after this I built an antenna insulator of a soda water bottle, the hose of a bicycle pump, and a saucer. This insulator was the pride of my wireless heart for several years.

Anyhow, my father got so interested that he presented little Lloydie with \$2.75—with which the aforementioned gentleman purchased a quarter-inch Rhumkorf coil from Sears-Roebuck. Doubtless the sale is recorded in their records—skeptics in doubt as to my veracity may inquire of this firm. I am a bit ahead of my story, however. Before buying the Rhumkorf coil, I tried to make one—a friend having given me a lot of snarled 36. Did you ever perform on about a pound of 36 that was beyond being ever straightened out? Well, I finally managed to get together a very much patched secondary and after many elaborate trials—and much scraping of a primary wire on a file, I decided that my coil was a failure.

One day I called PK—which was Newport's call in those days. Lo, and behold, he answered me, and asked who I might be. I wasn't sure whether to answer—having vague notions that my answering might cause a file of marines to escort me to the naval station. I did answer, however, and I

am mighty glad that I did. I still retain many warm friendships which were engendered at this and subsequent times. Is not my story becoming poetical.

Portiere poles served for inductance forms; mason jars for Leydens; hooks were used for switches and nails for spark gaps. Old pieces of tin leader were used as variables.

In those days nothing could be bought—everything had to be made—and believe me fellow “why or less men” many a cocoa box and tomato can has been slaughtered by the author. And he is glad of it. Having to make a thing is the best way to understand the working of that thing.

Although I have since bought several hundred dollars worth of stuff, I shall never regret the fact that I formerly had to make my own instruments. And some of my best successes have been obtained with the use of home made stuff. (I also like home made mince pie. Anyone reading this—that wishes to contribute a pie may shoot it right along.) Only the other day I wanted a form to hold a ball—a socket for ball and socket adjustment. Betcher can't guess what I did. I took an old clock key and bent it up to fit the ball—it was perfect. Would you ha' dun this, fellow bug?

C U all later.

Novel Arrangement of Wireless Code

By Elliott B. Holl,
Providence, R. I.

THE author has found by experience that it is much easier and quicker to learn the wireless code by receiving messages and by using a code chart of large dimensions, by means of which the beginner may find the letters as he receives them, than it is to try to memorize the code first and then practice it afterwards by receiving and sending. Large code charts have been prepared for this purpose and may be bought for a small sum of money. But these are only efficient when used in sending, for the letters are arranged alphabetically. Many may have noted the difficulty in picking out the dot and dash combinations in this code, since it is necessary to go over the whole chart in order to find the right combination which you have just received. All this takes time and you are therefore able to receive only the messages which are sent slowly. To better this condition, the writer has arranged the continental code, including numbers, punctuations, etc., in such a way that one knows immediately where to look for the desired combinations of dots and dashes. It is perhaps best to print this code on a large sheet of cardboard or paper, placing the whole in one column with an added space between the sets of combinations beginning with dots and those beginning with dashes. Place on the same chart the Continental code in its usual arrangement (to be used in sending) and keep the card in some easily visible spot near your set.

If, for instance, one should receive the combination he would know exactly where to look for combinations of dots and could therefore quickly find the letter equivalent. Again, if one received———... he

would know that this combination must be near the bottom of the chart since the code begins with three dashes. One will find that even without a knowledge of the code it is possible to receive messages at a fair rate of speed, and it should not be long before one gains a working knowledge without the bother of tedious study.

E .	T —
I ..	M ——
S ...	O ——
H	o ———
5	N —.
Period	K —.—
A .—	C —.—
R .—.	Call —.—.
L .—..	Y —.—.
Wait .—....	5 —.—.
Finish .—.—.	D —..
Comma .—.—.—	X —.—.
W .—.—	B —..
P .—.—.	Period —.—.
J .—.—.—	6 —....
1 .—.—.—.	G —.—.
U ..—	Q —.—.
F ..—.	Z —.—.
? ..—.—.	! —.—.—.
2 ..—.—.—	7 —.—.
V ...—	8 —.—.
3 —.—.—.	: —.—.—.
4—	9 —.—.—.

The Radio Station of Mr. P. W. Patch, Dubuque, Ia.



The aerial or antenna is of the "loop-type" consisting of six hard drawn No. 12 copper wires 100 feet long attached to ten foot spreaders at each end extending in a northwesterly direction. Each of the six wires is insulated from the spreaders by three glazed porcelain ball insulators joined in series. Two strain insulators having a tensile strength of 1,000 pounds suspend the aerial between two masts, besides providing a further insulation of 75,000 volts. One of the masts is a steel pole erected on the roof of the house, the top of which is 43 feet above ground. On high ground back of the house, a 40 foot steel tower has been erected having a 16 foot 4 x 4 securely mounted at the top that gives the aerial a height of a little over 50 feet at this end. On account of the tower being on high ground, there is a difference of nearly 30 feet in elevation of the two ends.

As to its details of construction, it closely resembles the towers erected on the Lackawanna Railroad Station, and the Boston Herald—but the "United Wireless Station" (WDR) in Detroit, Mich., is the one it is really designed after, although on a much smaller scale. The "rat tail" consists of six phosphor bronze wires of seven strands of No. 22 each, that lead from one aerial to two lightning arresters on the exterior of the building. From the lightning arresters two lengths of high tension pirelli cable serve as "lead-in" wires, connecting

the aerial with the apparatus in the operating room.

The apparatus is connected with the earth by means of a heavy stranded copper wire composed of 480 No. 30 B & S. gauge wires—the equivalent of a No. 4 single copper conductor. This is soldered to the ends of nine discarded boiler tubes taken from one of the government boats. The tubes are 12 feet long and are laid fan shape in moist ground, giving an exposed surface area of 100 square feet. This gives a ground connection nearly, if not equally as efficient as a connection to city water main—the absence of which made necessary this extra labor.

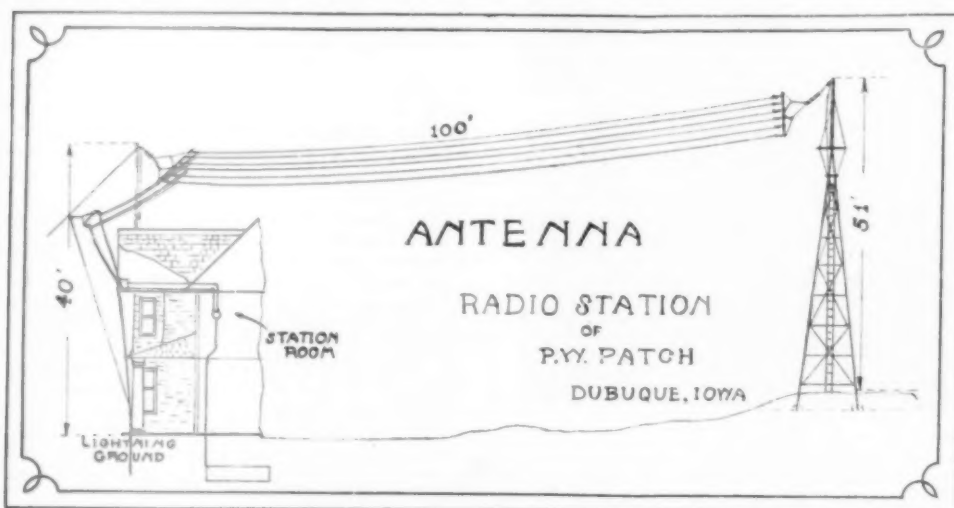
The receiving apparatus consists of two rotary variable condensers and one adjustable tin foil condenser contained in a cabinet made of bird's eye maple, stained mahogany with a loose coupler and universal detector mounted on top, together with various switches, etc., that enables any of the instruments to be cut in or out of circuit or to be adjusted to various wave lengths and capacities as desired. The receiving transformer has a range of about 600 meters, but for stations using longer waves than this, a large loading coil (double slide tuning coil) is used that increases the range to about 5,000 meters. This is a coil containing 630 feet of wire wrapped on a cylindrical form 18 inches long and 6 inches in diameter. In the construction of the loose-coupler, red fibre is used throughout; also in connection with the variable and fixed condensers. The variable condensers consist of 16 stationary and 15 movable aluminum plates, while the fixed condenser consists of 64 sheets of tin foil made adjustable by steps. In the detector, galena (found in this locality) has so far proven to be the most sensitive mineral tested out for long distance work. Several pair of Brandes receivers—including their Navy, Transatlantic and Superior types—complete the receiving set, and the extra pairs of phones have proven invaluable a great many times when other amateurs and friends have come around to listen-in.

The transmitting apparatus is of the switch-board type. At present it is in course of construction and will probably be some little time before every detail is completed, although actual tests will be possible some time in February. The board is inch and a quarter light pink Tennessee marble 55 x 36 inches divided into three panels and supported by an iron frame above a table on which the receiving apparatus sets. The center panel is 25% inches

wide; the side panels, 15 $\frac{1}{2}$ inches. Only the center panel is used for the mounting of apparatus pertaining to the transmitting set.

When completed, the set will consist of a one kilowatt closed-core magnetic leakage transformer having 5 primary variations of power operating on 220 volts and a secondary potential of 12,000 volts; a compressed-air spark gap with air pressure gauge-maximum pressure, 50 lbs. together with high pressure pump conveniently located for use

board construction. Low down in the center condenser in 4 sections—each section consisting of 12 plates and the whole connected in multi-series, adjustable in steps of 6, 8, 10 and 12 plates from the face of the board (not shown in picture as this has only recently been completed); a series condenser; an oscillation transformer—a Blitzen Radio coupler revised to make possible its adjustment from the face of the board; (also not shown in the picture) three "Kermel" switch-board meters—am-



while at the key; an 8 x 10 glass plate and a three-fold protective device consisting of a double condenser, graphite resistances and 3 point gap. Two pilot lamps, placed above the meters serve to illuminate the entire board. All switches, fuses, meters and apparatus requiring adjusting are mounted on the front of the board while the transformer, spark gap, condensers and oscillation transformer are mounted on iron frame work made of pipe to form an adjustable shelf in a manner common in switch-

meter, voltmeter and radiation ammeter. ter of the board is placed a "United Type" or loop-aerial switch, so far in receiving, however, the best results have been obtained with a plain straight-away connection. Two 15 ampere, 250 volt refillable cartridge fuses protect the entire board.

Two 6 ampere, 250 volt cartridge fuses protect the condensers provided to carry off the small charges from kick-backs; while the other fuses are provided to protect the voltmeter and pilot lights.

GOVERNMENT WISHES TO PLACE MORE EFFECTIVE CONTROL OVER POSSIBLE INTERFERENCE

Special License and Commercial stations have been requested by the Government Radio Service to keep a record of interference experienced by the operators in the course of their regular duties. This report is to be forwarded to the Radio Inspectors weekly. This is to contain notes on interference of the following character: "Amateur broadly tuned," "Amateur interference on — meters," "— station testing on — meters." The reports themselves need not be more formal than a memorandum.

It is not intended to adopt heroic measures nor would it be desirable for an operator to deliberately look for interference; the Department simply wants the actual interference which an operator experiences in his regular work. A great deal of interference is caused needlessly and every operator should use a little care in testing when he might cause interference. If you are going to test, do not send by the hour or even fifteen minutes without listening in for possible interference.

RADIO COMMUNICATIONS BY THE AMATEURS

38 Maple Ave., Stamford, Conn.
Jan. 6, 1916.

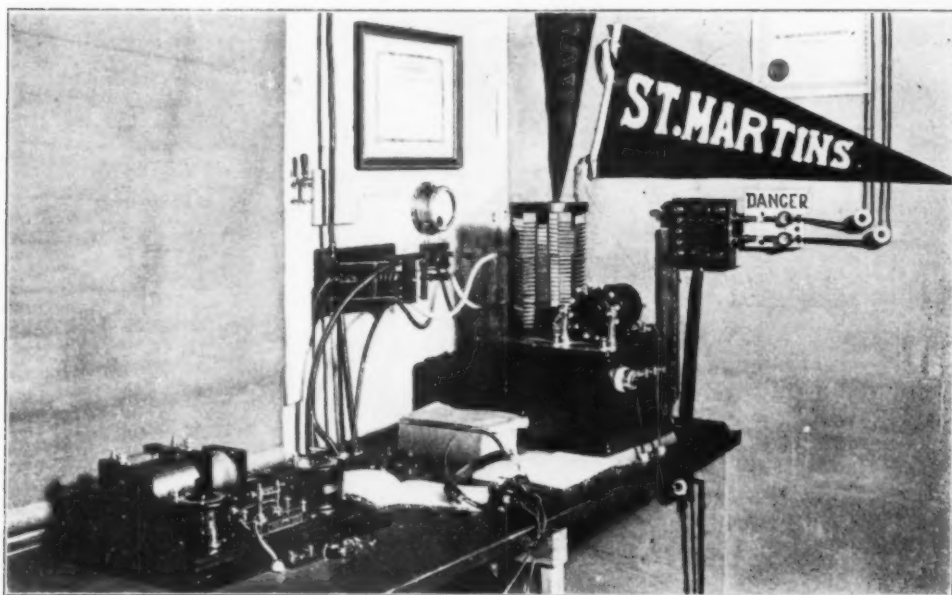
Mr. C. D. Tuska.

Dear Sir:

Have received first two issues of "QST" and think they are great.

I recently came home after being on a six month's trip on the S. S. Somerset (KSV) and I find that there have been numerous late developments in the "Ama-

One fault, however, is that very little has been done to help the "Spark Coil Amateur" do long distance work. Many amateurs are unable to have current installed in their homes either because they live too far away from current wires or else they cannot afford the cost of installation. Cannot amateurs find some means by which long distance work with a spark coil may be improved?



ST. MARTIN'S COLLEGE RADIO STATION

Some excellent long distance work has been done by this station. The antenna is 330 feet long, with an average height of 90 feet, and six wires with a spacing of four feet. The sending apparatus is a Murdock 1 kw. transformer, rotary, six sections of moulded condenser, and a special helix. The receiving apparatus is a Murdock loose coupler, two variable condensers, 4,000 meter loading inductance, fixed condenser, crystal detectors and 2400 Ohm phones. The sending range is 400 miles, 7CE, Boise, Idaho. The sending record was 650 miles, 6RJ, Lone, Calif. on a Galena detector; made in May, 1915. The receiving range is about 1500 miles and a local weather report is sent out "QST" every evening, except Saturday at 9:05 p. m. This report may be copied by all the amateurs in the Seventh District.

teur World," some of which I know practically nothing about, for instance the Oscillating Audion, which I believe to be due largely to the co-operation of the amateur operators through the American Radio Relay League.

I find very few points on which to criticize the advanced amateur and his work.

I have tried numerous experiments but can give only one suggestion for better work. That is: Place two bridges across the vibrator, one bridge not to be connected to the vibrator or to the batteries but to be placed across the vibrator. By means of a thumb screw the note can be varied. This arrangement not only produces a

high, pleasing note, but also increases the radiation.

Yours very respectfully,
V. A. HENDRICKSON.

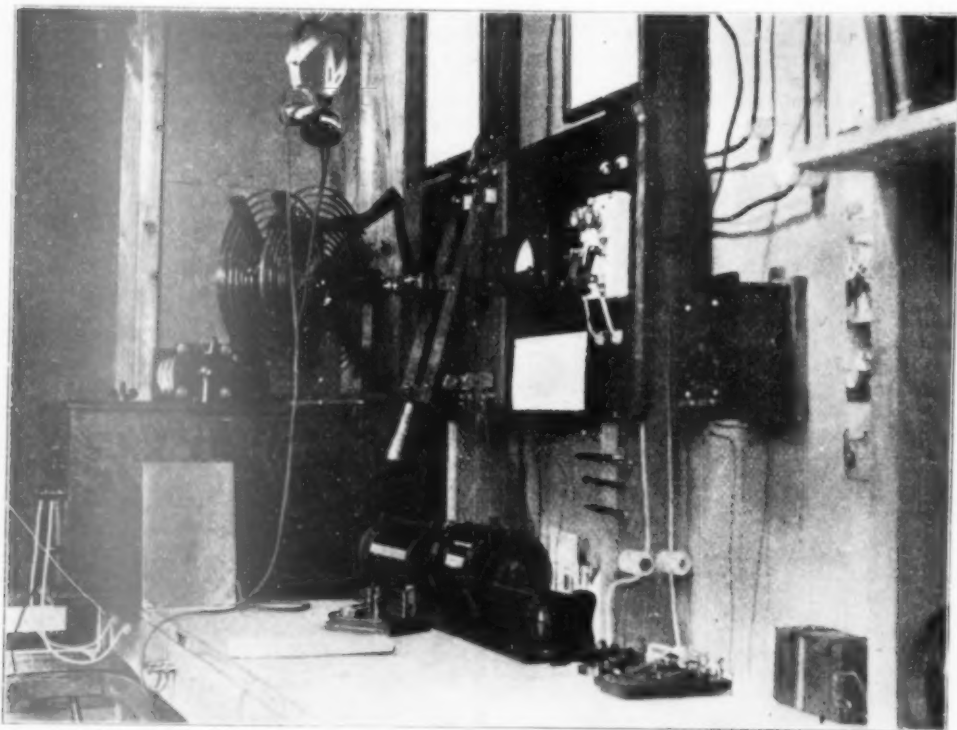
Mr. R. M. McLain of Huntsville, Alabama, writes in part:

As I was passing through the lonely hills of North Alabama, several days ago, I noticed a young lady of about seventeen years standing on a barrel at the foot of an aerial mast, repairing the aerial. I asked her what the trouble was and she

I glanced about the yard and saw several mules and cows, a yard full of chickens, an old-fashioned spinning wheel, in perfect shape, and with thread on it. It looked as if the young lady could operate anything from an old spinning wheel to a modern wireless telegraph.

Mr. W. B. Pope, Athens, Georgia, writes:

I use a Packard one-quarter kilowatt transmitting set (transformer), balance of set of my own construction. I am in constant communication with Macon, Georgia.



A WELL EQUIPPED RADIO STATION IN YORK, PA.

These two illustrations show a LEAGUE Station owned by Mr. H. G. Miller of York, Pa. The aerial poles are 60 feet high, and 85 feet apart. The station itself is at the foot of the pole in the foreground, and the house is devoted entirely to wireless. For transmitting, a three quarter kilowatt set is used. The condenser is of the glass plate type in oil. Everything throughout the station has a neat business-like appearance.

explained that the wind blew down the mast every time she put it up. She had repaired it three times, in two weeks.

"Do you catch anything?" I asked.

"Oh, yes," she replied, "I used to, but do not now. Do you know anything about fixing a detector?"

I examined the neat little set and found it O. K. I asked her if she liked the work.

"Oh, yes, I am crazy about it; I listen all the time."

a distance of 100 miles from here. I have just received a letter from Mr. Charles W. Weber, Abington, Pennsylvania (about 10 miles north of Philadelphia) stating that he has been hearing me as loudly as he has been hearing a one kilowatt set located within 200 miles of him.

In addition to a Packard one-quarter kilowatt transformer, I use three sections of Murdock moulded condenser, a high-speed rotary gap, giving almost 1,000 in-

terruptions per second, an oscillation transformer, glass insulator, of my own make, and wound with edgewise copper strip, and



Radio Station of H. G. Miller at York, Pa.

an aerial only 75 feet high and 200 feet long, input to transformer, as when heard by above named party, three amperes.

This is one of the best records I have so far heard of, as the distance from Athens, Georgia, to Philadelphia, Pa., is between 700 and 800 miles. This was at 9:10 P. M. or thereabouts and when conditions for wireless were not the best.

AMPLIFYING QUESTIONS

To the Editor "QST,"

In the various Armstrong circuits, is the increase in the strength of signals due entirely to the beat or heterodyne effect, or are there any other effects noticeable which cause added response in the phones?

If there were another type of generator, for undamped waves, as efficient as the audion, and if the beat effect produced by the generator were utilized on an ordinary detector circuit as sensitive as the ordinary

audion receiver circuit, would this circuit be as sensitive and satisfactory as an Armstrong circuit?

What is meant by "increase in audibility"—an amplifier concern claims to have an instrument that increases the audibility 1500 times. Does this mean that the sound wave produced has 1500 times the amplitude and what relation has it to the number of times the signal strength is increased?

(Signed) EDGAR FELIX,

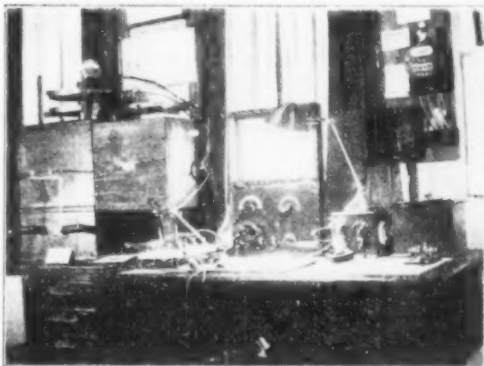
New York City.

In the various Armstrong circuits, the increase in strength of signals is due to amplifying effect as in the ordinary amplifier rather than the heterodyne principle. Of course, in the Armstrong circuit, these two effects are combined, but the real increase is due to amplification.

It is the writer's opinion that another type of generator such as you mention would not be as efficient as the Armstrong circuit. This is due to the peculiar repeating action which is obtained between the inductance coils.

"Increase in audibility" means that the instruments amplifies a given sound a certain number of times when a given factor of loudness is taken as the audibility unit. That is, a certain strength of signal may be taken with an audibility of one, then the amplification or increase in signal strength is a given number times the audibility.

A more complete discussion of these questions will be found in Armstrong's article in "The Proceedings of The Institute of Radio Engineers," Volume 3, No. 3.



RADIO STATION 9IK

This station has done a great deal of successful relaying which is probably due to its well-constructed apparatus. Mr. Mathews of Chicago, Ill. is the owner of the station. He has spent a great deal of time in getting everything about his set "just right." Do you do the same?

New York, Feb. 7, 1915.

My dear Mr. Tuska:

Allow me to thank you for your very courteous and carefully considered reply to my letter of the 22nd ult., regarding Armstrong circuits.

Not only have you answered my questions completely, but you have shown me the energy and seriousness of the work you

whose duties it will be to establish and maintain a circulation library of the latest and best books on wireless, and the current magazines on the same subject. A second committee, the electrical, was appointed to take charge of the experimenting station of the club. This committee will perform its experiments before the members of the club.



ONTARIO RADIO STATION

C. L. Todd, Rochester, N. Y.

The sending set is a "Blitzen" one-half kw. rotary set, mounted in a mahogany cabinet with meters and control switches on a marble board. The sending set is in a separate sound proof room. The receiving apparatus is a Clapp-Eastham type "D" tuner, two Cambridge variables, DeForest audion, Stromberg phones, and loading coils controlled by telephone cans.

A mahogany cabinet with a hard rubber face contains the receiving instruments. The antenna made of phosphor-bronze wire is 50 feet high, and 62 feet long. Mr. Todd has been getting very good results lately and would like to hear from amateurs who receive his "Sigs."

have undertaken. I am sure that the American Radio Relay League is and will be a great and thorough success—imitation and rival leagues notwithstanding.

Thanking you again, I am

Most sincerely yours,

(Signed) EDGAR FELIX.

NEW ROCHELLE RADIO CLUB

At a meeting held on Thursday night, Feb. 3, 1916, the amateur wireless operators of New Rochelle, N. Y. organized a club to be known as the Radio Club of New Rochelle. The purpose of this society is to better and further advance wireless telegraphy in New Rochelle.

Of an initial membership of twenty the following officers were elected: President, John Bucknam, Vice President, Etienne Donovan, Secretary-Treasurer, Thomas Havard, and Press Agent, Edward Bettels.

The president appointed a committee

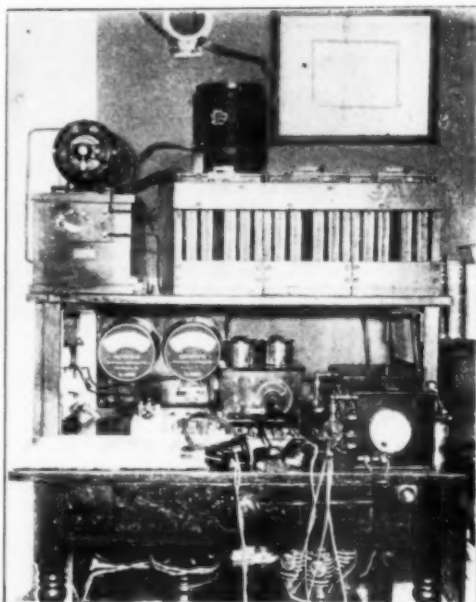
FALL RIVER, MASS. HAS NEW CLUB

The "Fall River Amateur Wireless Association" has recently been formed. Its object is to advance interest in wireless communication in Fall River and vicinity. The officers are: William H. Buffinton, President; Dana Hilliard, Vice-President and Harold C. Bowen, Secretary.

"PORTABLE AEROPLANE AND TRENCH RADIO SETS"

The Radio Club of America Holds Meeting.

At the last meeting of the Radio Club of America, Mr. William Dubilier presented



ONE OF THE SPECIAL LICENSE STATIONS

Radio station 1ZW is owned and operated by Mr. William H. Allison of Worcester, Mass. Mr. Allison has done a great deal of relay work and his station is one of the stars of the New England States. There are few stations which can boast of a more complete equipment.

a paper on "Portable Aeroplane and Trench Radio Sets" with special consideration of a type of apparatus developed by the author for utilizing direct currents in producing musical notes without the use of a motor generator set and revolving spark gaps. Mr. Dubilier has recently returned from France and England where he made experiments with these sets. He very interestingly described in detail, with lantern slides and apparatus, the installations now being used by the Allies for directing artillery fire, and communicating between trenches.

Mr. A. S. Blatterman presents very interesting paper before Institute of Radio Engineers.

At the meeting of the Institute of Radio Engineers, held Jan. 5th., a paper on "Variations in Nocturnal Transmission" was presented by Mr. Blatterman. It gave a very interesting account of experiments in nocturnal transmission which have been carried on between the University of North Dakota and Washington University in St. Louis, Mo. A number of peculiar effects of value to experimenters in the radio field were quite clearly brought out.

The Club invites all amateur radio stations in the United States to communicate with them through their secretary, Thomas Havard, 48 John St., New Rochelle, N. Y.

Receiving with a Pancake Tuner

By E. E. House, Battle Creek, Mich.

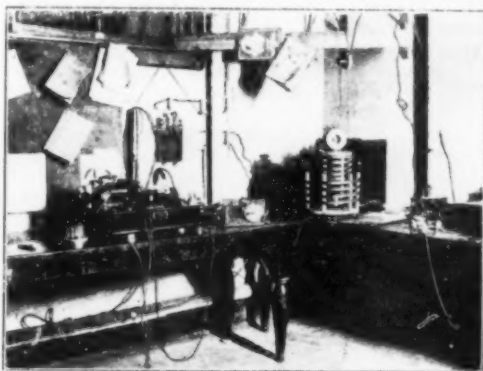
EDITOR'S NOTE: Mr. House is a firm advocate of the pancake type coils. In this article he tells of the excellent work which may be done and he gives a list of amateur call letters he copied in one evening. Many of our readers may be surprised to see their call letters here as they do not all know their long distance records.

IT is generally understood that the pancake receiving coils are not an efficient type. The writer has been using one for some time and is very well satisfied. In fact, recently, he built over a whole new receiving set into pancake style; even to the 10,000 meter set for undamped waves.

The following is a list of stations that the writer hears almost every night, using the single audion (no amplifying arrangement). The audion is a poor one having been knocked down several times so that it sometimes does not work for several days at a time: 8ER, 8EZ, 8GV, 8XAU, 8LF, 8YO, 8PL, 8AMN, 8XP, 8SN, 8ZN, 8AAE, 8LE, 8PB, 8MW, 8FW, 8KP, 8PE, 8PC, 8OZ, 8LD, 8RD, 8CT, 8PP, 8TD, 8MV, 8CR, 8AD, 8PW, 8MZ, WP, WPR, 8JA, 8GG, 8CW, 8ABO, 8AHR, 8CB, 8LW, 8NH, 8US, 8NA, 8CL, 8WP, 8YO, 8CU, 8KU, 9AC, 9YN, 9BD, 9NF, 9TM, 9GY, 9IT, 9AA, 9DU, 9AAB, 9GHS, 9NN, 9CY, 9SY, 9SP, 5BJ, HED, HB. The writer has also heard 5BJ with Galena; also 8AEZ, 8NH, and 8WP very easily. Some of these stations are using as low as one-quarter kilowatt sets. It may be of some interest to the operators to know that they have been heard so far with their sets. Most of their messages came in quite loud; easily loud enough to be read.

The writer has also heard NPF, Cape Blanco, Oregon, on a 600 meter wave. His

coil takes in 600 meter waves and he therefore gets all of the Lake boats and stations around the lakes, even as far as Port Arthur. He hears NAA loud enough at times to be able to read him ten to fifteen feet from the phones. His aerial consists of four wires, five feet apart. One hundred feet flat top, fifty feet high, inverted L type. The readers may be interested to know that twenty-eight of the above stations were received between 8:45 and 9:20 on the evening of January 29th.



ANN ARBOR, MICHIGAN, RADIO STATION

This shows a flashlight picture of the station in the Y. M. C. A. Radio Club. For transmitting a 1 kw. transformer is used with an aerial 75 feet long, and 70 feet high. This station has worked 1ZL, 3NB 8ZO, 8YL, and has been heard by many stations in the East. The Club has at its disposal an audion detector and for receiving, uses an aerial 200 feet long 150 feet high at one end, and 60 feet at the other. The call YMCA and Mr. Walter Hoffman, Secretary of the Club, would like to hear from amateurs who hear their signals.

An Interview with the Inventor of the Crystalloi Detector

The writer, hearing the wonderful 5,000 mile record made on the Crystalloi Detector, decided to see Mr. Turney and interview him for "QST."

One day last month, the writer found Mr. Turney in his laboratory and asked him for information concerning the use and theory of his new Detector. The publishers of "QST" take great pleasure in presenting the results of this interview.

First, Mr. Turney explained that his Crystalloi Detector was composed of a finely divided alloy, a great many particles of which are brought into contact with a highly sensitive mineral and for this reason, innumerable sensitive spots can be found with no more adjustment than turning a little thumb screw. The Crystalloi has a great advantage over other Detectors inasmuch as there are several fine, light metal points in contact with a sensitive mineral instead of the single point which most Detectors have. The Detector is so compactly made that it cannot get out of adjustment and it never loses its sensitive-

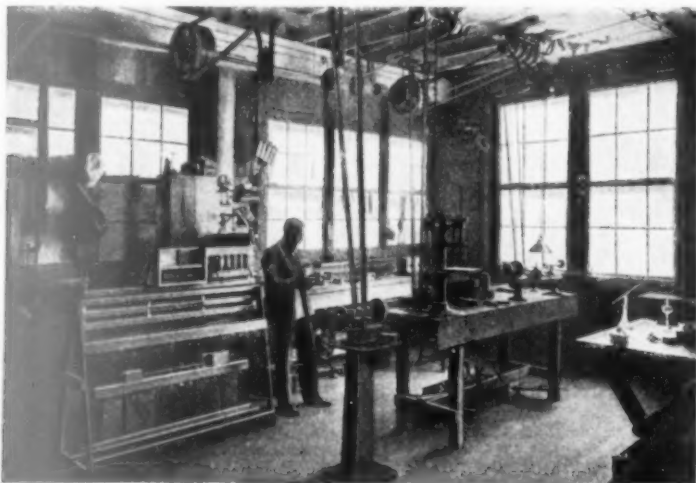
ness. Further advantages lie in the fact that there is no cost of operation;—the Crystalloi requires no battery or potentiometer and is ever ready to serve under all conditions.

"The latest record made by a Crystalloi," said Mr. Turney, "is 5,000 miles. Mr. R. J. Robey, of Richmond, Va., heard a station at Lahaina, Hawaiian Islands: Mr. Robey heard the station four different times. We have great hopes for the Crystalloi."

"Are there many in use?" asked the interviewer.

"We have sold 10,000 Crystallois all of which have given satisfaction, and have seen hard service. About 600 are in commercial use, and the operators are more than satisfied. They all get excellent results."

Then the writer asked Mr. Turney if he had any new improvements in the Radio field. The reply was that several new instruments were being designed for amateur use and a catalog of the same was being prepared.



Mr. Turney in his Laboratory



The article on audion bulbs in this issue, written by Mr. A. B. Cole, the Sales Manager of the DeForest Radio Telegraph & Telephone Company is recommended to every wireless operator whether amateur or commercial. Of all instruments and devices used in radio work, the audion bulb is by far the most difficult to learn how to handle. Probably 90% of the amateurs of the country do not know how to get the best results from an audion bulb nor how to keep the bulb in best working condition. The information given in Mr. Cole's article is the first time that all of the latest details known about the audion have been put together in one article in such form that the amateur can understand it. We predict an immense improvement in receiving ability throughout the country as a result of the amateurs in the League reading this article of Mr. Cole's.

The audion bulb is regarded by the amateur in general as one of the expensive luxuries. In talking with many amateur station owners, it seems that the impression prevails that not only does a bulb and its accompanying set cost quite a bit, but it costs a lot to replenish burned out bulbs. An ordinary bulb was represented by \$3.00 and the "X" bulb with its greater sensitiveness at \$5.00, if we remember the prices correctly. It was the usual history of every friend who had purchased an audion that he burned his bulb out in the first few weeks and this had to be renewed. It seemed an expensive thing to keep up.

We venture to predict that with the added light on this vitally important receiving device, which Mr. Cole's article sheds, that the cost of upkeep on account of burned out bulbs, will be much reduced and that in time many more amateurs will feel that they can afford an audion. In most every one of the especially good League Relay stations, which we have illustrated in QST, the audion bulb figures as the receiving device. Some amateurs make use of the audion as a means for receiving continuous wave signals, and this, if practical, will add still further to the importance of the audion in the amateur minds. We understand, however, that up to this time, the DeForest Company do not approve of the use of the

audion for this purpose. In the meantime, let every one of us whether he owns an audion or not read carefully Mr. Cole's article and then put it aside for further consideration later on. It is worth keeping.

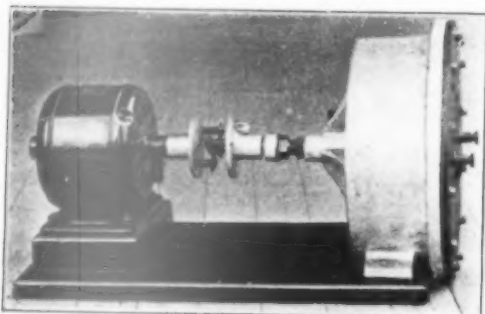
We really seem to be getting there on the Trunk Line matter. The number of letters received from amateur station owners throughout the country since Mr. Maxim's article was printed in last month's issue, and the plan he outlines in this month's article, indicate clearly that in the near future we shall have regular working divisions the same as a railroad organization.

The idea of this sub-division and local control of each Trunk Line is especially promising because of the fact that it divides up the labor. There is so much to do that a lot of people must be identified in the job in order to carry it on. Establishing local stations at San Francisco, Chicago and some point near New York, is distinctly the next thing for us to do. Let every one of us who actually operates and who is qualified to vote, send in his pick for the best local headquarters in the cities mentioned. Don't delay, and we can get the scheme into working form before the static begins next season. Never mind the remonstrance from our overworked Secretary. A few more thousands of letters in his mail will never be noticed in the pile.

As we go to press with this issue Mr. Kirwan's country wide relay test has just been pulled off. At this writing, we have practically no information as to how far the message got, and how badly it became garbled. We do know however, that there is every indication that an extremely fine record was made, and we expect to see this confirmed later. Mr. Kirwan, 9XE of Davenport, Iowa, who originated the relay, is one of the League members and he has promised to send in to QST, all the dope as soon as he receives it himself. When it is printed it will be of great interest and assistance to the rest of us.

There will be some unexpected developments, in the matter of long distance work. For example, we have already ascertained that Mr. Read, 10N in Springfield, Mass. heard 9XE when he first started the message out in Davenport, Iowa, and that he

heard the others repeating it on the way east and when Wheeling, W. Va. did his sending, he had the message good enough so as not to bother with taking it down any more. When we hear from the Pacific Coast stations, we expect to find still more surprising things. Somebody has predicted that as a result of this relay demonstra-

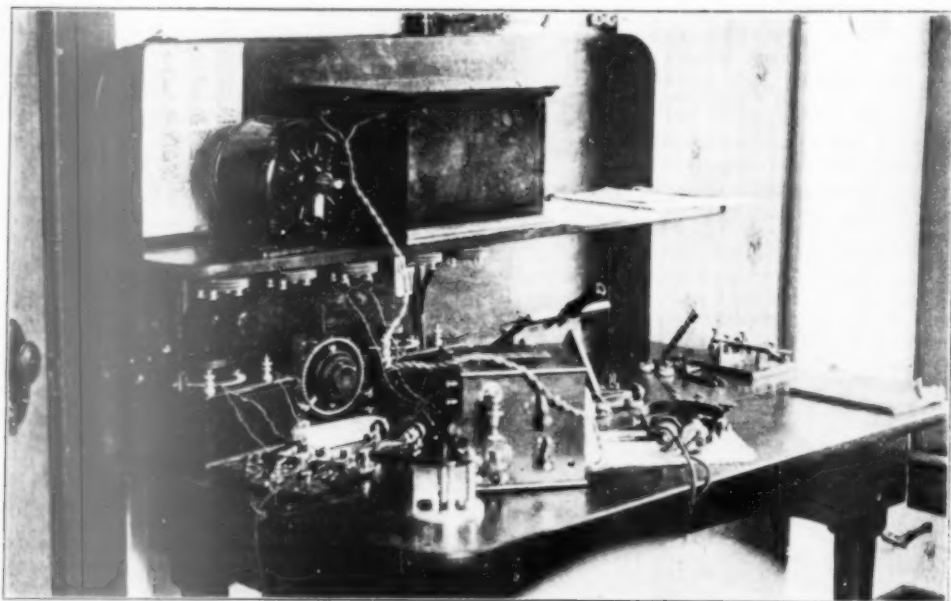


You are respectfully requested to discontinue transmitting during the Q. S. T. Reports of the Naval Stations. These reports are sent out every four hours. Complaint has already been made to the Navy Department that much QRM has been given during the Time Signals of N. A. A. and the weather and obstructions reports of the NA-Stations. Further notice has been brought to the use of excess power at other periods. Please advise ALL Amateurs to heed this warning and QRX. Safety first. 3TQ.

The Publishers of "QST" wish to express their thanks to Mr. Andrews for bringing this to their attention. QRM during these periods is a very serious affair and the LEAGUE can do no more than most earnestly recommend than every amateur adopt this rule of Keeping Out during these important periods.—Editor.

MR. FLANDERS OF BOSTON, SAYS:

I have received all the "QST's" and appreciate the magazine. It gives one such



AMERICAN RADIO RELAY LEAGUE STATION 8ZI

We have, in Mr. Roy C. Burr's station, one of the best east of the Rocky Mountains. This station which is located in Norwalk, Ohio, has probably done more relaying than any other station along The American Radio Relay League Trunk Lines. The smaller illustration shows a two kw. rotary quenched gap designed by Mr. Burr. With this gap, Mr. Burr radiates 514 amperes on a short wave, with a 460 cycle note. Using 880 watts input, this station has worked 900 miles. A complete description of the gap will be published in an early issue of "QST."

tion, we will be able to get all the way across the Continent in two relays, that is, three stations.

delightful little glimpses of the amateur "as he is."

QST, QST, QST, DE 3TQ
This Means You. An Important Suggestion

ERRATA

The word Amplifier should be substituted for the word Audion in the fifth line of the

second paragraph, second column on page 24 of the February issue. In this same article, under Notes, Power in kilowatts.

COMING ISSUES OF "QST"

Among the other good things in store for subscribers of "QST" are articles on "Tuning," "Receiving," "Long Distance Work," and an article on wireless telephony describing a system which worked well on sixty cycles. This article will tell you how the Secretary of the LEAGUE carried on a number of experiments and succeeded in transmitting music a distance of twenty-five miles with one-eighth kilowatt on sixty cycles. It was practical work and you will be pleased to see the article. A number of well-known writers are going to contribute articles to "QST."

INTERESTING MEETING OF THE RADIO CLUB OF AMERICA NEED NOT DISMANTLE RADIO

Collector Malone was notified yesterday by the Treasury Department that, in accordance with the advice of Secretary of the Navy Daniels, it is unnecessary to dismantle the radio apparatus of bunker coal steamers of belligerent countries which remain in port for so short a time that it is

not necessary for them to enter or clear. In such cases, however, the Collector is instructed to deliver to the master of the vessel a copy of the printed regulations issued by the Navy Department and inform him that, as the vessel will not have to enter and clear, he will not be required to seal his radio apparatus or to lower his antennae, but that the apparatus must not be used in any way, either for transmitting or receiving, until after the vessel has left the limits of the port.

THE GROWTH OF "QST"

Along with the rapid development of THE AMERICAN RELAY LEAGUE, came the growth of "QST." Did you notice the four additional pages in the February number? There are four more pages in this issue. That means, we have eight more pages than when we started; thirty-two pages instead of twenty-four. "QST" will continue to grow, if you do your share. If your trial subscription expires with this number, renew it immediately. If it is going to expire next month, don't wait until it expires, renew it today and you will get "QST" for a year. It's very important that you renew your subscription promptly. A delay may mean the loss of a number.

A New Receiving Set

We are now offering our new amateur receiving set, which, while being moderate in price is exceptionally efficient and pleasing in appearance. It consists of a receiving transformer of special design, detector, fixed and variable condensers and loading coil, all mounted on a finely finished base, connected ready for use. It is of sufficient size to allow the reception of time signals from Arlington when used on any amateur aerial, and is the lowest priced receiving set of high quality ever offered for sale. Our bulletin illustrating and describing this receiving set will be furnished to anyone upon receipt of a two-cent stamp. Parts of same are sold separately

We now have in stock for immediate delivery the New De Forest Audion Detector, much improved and by far the best detector on the market. Get our bulletins

The Wireless Mfg. Company
Canton, Ohio

Latest List of Additions to American Radio Relay League Stations

CALIFORNIA

Alameda	R. S. Farrell	2328 Pacific Ave.	6TR
Berkeley	Wallace H. Leland	917 Indian Rock Ave.	6WL
Capitola	Theodore Stowe	41st Ave.	6CJ
East Oakland	W. L. Gibson	2324 Dennison St.	6US
Fullerton	Lee R. Potter	424 Cor. Maple & Spadra Aves.	6CR
Ione	R. A. Miller		6RJ
San Francisco	John Stauffer, Jr.	-601 Broderick St.	6JR
San Jose	Paul U. Clark	898 South 8th St.	6AU
San Jose	Roy A. Wilkins	532 North 17th St.	6PS

CONNECTICUT

Kensington	A. H. Edgerly, Jr.		1DT
New London	Perry Stone	15 West St.	1AES
Stamford	Stuart Sandreuter	Palmers Hill	1DX
Tariffville	Kenneth Dewey		1DM

FLORIDA

Ankona	Raymond A. Saeger		4BV
Miami	Wm. A. Marsh	R. F. D. No. 1	4AQ

GEORGIA

Colege Park	Francis Merriam		4CL
Decatur	George A. Howald		4CO

ILLINOIS

Buquoin	C. J. Zimmerman	117 South Division	9FY
Champaign	Sherman S. Garrett	504 W. Washington St.	9WO
Chicago	Raymond W. Eling	6637 Greenwood Ave.	9OR
Chicago	Lane Radio Asso.	Cor. Sedgwick & Division St.	9NL

INDIANA

Cannelton	John R. Irvin	4th & Taylor Sts.	9DA
Fort Wayne	George W. Carter	High School	9PC
Fort Wayne	L. C. Young	High School	9PC
Indianapolis	Harold Barton	20 West 26th St.	9AAR
Osceola	Leland Miller	R. R. 1 Box 18	9VJ

IOWA

Des Moines	Ralph Knouf	1344-21st St.	9LU
Dubuque	George Wright Bonson	287 East St.	9TM
Dubuque	Joseph D. Brennan	501 Alpine St.	9SA
Iowa City	Prof. A. H. Ford	St. University of Iowa	9YA
Lamoni	Arthur B. Church		9WU
Sioux City	Darrel Cyr	109 W. Ind. St.	9TO

KANSAS

Fort Scott	Kenneth W. Wright	418 West 8th St.	9JV
Kansas City	Wilbur Witcraft	1941 Thompson St.	9TP

MARYLAND

Middletown	Mark Biser		3CY
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MASSACHUSETTS

East Sangus	Edward Lipson	38 Overlea Ave.	1SC
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MICHIGAN

Detroit	Frederick Bornman	134 Delaware Ave.	8QJ
Detroit	Edwin Boyes	170 W. Willis Ave.	8HL
Marquette	Albert St. Cyr, Jr.	319 Harrison St.	9HK
Fort Henry	Irving Bell	819 Wall St.	8AIF
Port Huron	F. J. Scupholm	939 Court St.	8AGR

MISSOURI

St. Louis	Lester A. Benson	2706 Stoddard St.	9VP
St. Louis	J. A. Crowdus	5047 Washington Ave.	9HN

NEBRASKA

Lincoln	T. C. Rice	2400 South 14th St.	9XT
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NEW JERSEY

Fanwood	William S. Becker		2ACX
Great Notch	Herbert Warner		2DN

NEW YORK

Buffalo	H. L. Moersfelder	34 Ketchum Place	8HP
Buffalo	Sydney Rounthal	116 E. Tupper St.	8ATN
Gloversville	Raymond S. Baker	39 Steele Ave.	8FF
Gloversville	Otis K. Durfee	310 South Main St.	MWD
Gloversville	H. S. Paddock	310 South Main St.	MWD
Lockport	Robert S. Bishop	413 Locust St.	8AGL
Oneida	Lloyd Stratton	44 Seneca St.	2AJQ
New York City	Roland W. Porter	1991 Washington Ave.	2DQ
Valley Stream, L. I.	J. O. Smith	47 Catherine St.	2LK

NORTH CAROLINA

Winston Salem	C. W. Clodfelter		4CK
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NORTH DAKOTA

Pembina	Ryan Booker		JAA
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OHIO

Cambridge	Roy W. Waller	837 North 12th St.	8CL
Cleveland	J. L. Russell	2125 East 79th St.	8AL
Dayton	Stanley Copp	5 West Mon. Ave.	8LT
Dayton	Carl Linxweiler	140 Eagle St.	8LJ
Hamilton	Willard Schreck	448 Forest Ave.	WS
Mansfield	Chester Finley	R. D. No. 9	8AFD
Mansfield	Paul L. Hoover	32 Poplar St.	8IC

Newark	Carl G. Howard	183 South Pine St.	8AGF
Norwalk	Roy C. Burr	68 East Elm St.	8RD
Norwalk	Allan Chester	50 East Elm St.	8NN
Springfield	J. Warren Wright	1119 So. Fountain Ave.	8NP
St. Marys	Mrs. Chas. Candler	203 North Ash St.	8NH
Toledo	Scott High School	Collingwood Ave.	8JD

PENNSYLVANIA

Allentown	Stanton E. Nadig	203 North 4th St.	3GE
Clarks Summit	Stanley Phillips		8HX
Curwensville	D. L. Irvin		8AY
Falls Creek	Francis Senais		FTS
Philadelphia	Edward C. Andrews	22nd & Morris Sts.	3TQ
Philadelphia	Arthur Wilson	355 45th St.	3BU
Philadelphia	John E. Wynkoop	4048 Chestnut St.	3AFL
Reading	Fred J. Andersen	735 Lincoln St.	3DD

RHODE ISLAND

Providence	Elliott B. Hull	484 Hope St.	1UX
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SOUTH CAROLINA

Charleston	William F. Allston	8 Colonial St.	4CB
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TEXAS

Austin	Wesley Tilley	303 East 10th St.	5AL
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VIRGINIA

Portsmouth	C. V. Nichols	218 Crawford St.	3TI
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WASHINGTON

Seattle	Harry Curtis	215 Boston St.	7UN
Wilkeson	Lester O'Brien		7LO

WEST VIRGINIA

Keyser	Liller & Watson	116 Aloie St.	8MU
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WISCONSIN

Bayfield	Leonard Kranzfelder		9KE
Salem	Lester M. Smith		9MA
Stoughton	Owen R. Terry	202 Prospect Ave.	9HQ

Well, well! **88 New Members** this month!

Are you one of 'em?

You should be

Exchange, For Sale and Wanted

"Second Hand Apparatus"

In order to facilitate the exchange and sale of second hand apparatus "QST" will print, free of charge, want and for sale ads. up to a reasonable number of words. The publishers reserve the right to withhold any ad. which is against the policy of this department

FOR SALE OR TRADE—Sending and receiving set including Brandes 2000 ohm "Superior" head set, also Blitzen high frequency coil. Wanted: $\frac{1}{4}$ K. W. transformer, mounted or unmounted. P. E. Nelson, Ft. Smith, Ark.

FOR SALE—An R-J4 Audion, good as new, but with bulb burnt out. First good offer takes it. Other materials also for sale. Harold Burhop, 1945 N. 7th St., Sheboygan, Wis.

FOR SALE — Wireless set consisting of loose coupler set, with detector and condenser on base; 1 pr. Murdock phones; 1 Mesco key, value \$2.00; $\frac{1}{2}$ " spark coil, wire and switches. Price \$10.00, or will exchange for a wheel. Frank Cummings, 2132 Washington Ave., Bronx, N. Y.

FOR EXCHANGE—One Coloy receiving transformer, \$5.50; one 1" spark coil; and one electrolytic interrupter. Wanted: Murdock or Blitzen variable. Geo. M. Hearne, Carthage, Ill.

FOR SALE OR EXCHANGE—Wireless receiving and transmitting outfit in whole or in part. This set has produced excellent results but the owner can no longer use it on account of studies. Francis B. Southwick, 176 Waban Ave., Waban, Mass.

FOR EXCHANGE—110 V. D. C. motor for 110 or 220 V. A. C. motor or anything of equal value. Motor is in practically new condition, and is suitable for rotary gap. A. Saenz, 146 West 65th St., New York.

FOR EXCHANGE — One Dundoplex key (similar to Vibroplex), nickel plated, value \$15.00, for pair of 3000 ohm phones and high-speed motor, an Audion detector, or other wireless goods. F. S. Morrison, 1376 So. Lincoln St., Denver, Col.

FOR SALE—One pair Brandes 3200 ohm Navy Type Head-set, just received from factory where both were magnetized and one receiver re-wound. The phones are in perfect condition. Price \$10.00. Robert W. Orrell, 87 Frederick Ave., Detroit, Mich.

FOR SALE OR EXCHANGE—Pair of E. I. Co.'s 2000 ohm receivers for a good variable, 43 plate type; 60 ft. of copper ribbon, $\frac{3}{4}$ " x 1-64", valued at 4c. a foot; 9 glass plates, 18" x 18" x 3-32", with foil; brass switch points, lacquered, $\frac{1}{4}$ " x $\frac{1}{4}$ " with 8-32 thread, fine for rotary gaps. Frederick Gamble, 2412 Putnam St., Toledo, Ohio.

EXCHANGE FOR SENDING APPARATUS—A complete receiving set, with exception of phones. Does 1300 miles. Also oscillation transformer and variable sending condenser. Arthur Mekeel, Box 523, Highland, N. Y.

WANTED—A pair of good phones and a rotary variable condenser. Have a Browne No. 2 camera and daylight developing tank for same; also other apparatus. R. L. Pentland, 5225 Woodlawn Ave., Chicago, Ill.

FOR SALE—One pr. 2000 ohm amateur head-set (E. I. Co.); $\frac{1}{2}$ K. W. transformer coil; one spark gap (both E. I. Co.); one condenser, suitable for above coil; one loose coupler (800 meter) for Audion, cash, or something suitable. Debert Westover, Marysville, Wash.

FOR SALE OR EXCHANGE—Six Murdock sections; two Ferron detectors; one key; Blitzen variable condenser parts; Perikon detector, three K. W. fixed gap; other material and parts. Roy C. Burr, 68 East Elm St., Norwalk, Ohio.

WANTED—Audion detector No. R. J. 4. Must be reasonable. Harold I. Sticher, 15 Bedford Ave., Monticello, N. Y.

FOR SALE OR EXCHANGE — $\frac{1}{2}$ K. W. Blitzen transformer; Ferron detector stand; 1500 meter tuner; $\frac{1}{4}$ " coil; 20 speed rheostat for gap motor; 1000 ohm receiver complete. Maurice B. Rann, Morrice, Mich.

FOR SALE—Four inch Mesco spark coil in excellent condition. Justus Agnoli, 16 Purvis St., Long Island City, N. Y.

FOR SALE OR EXCHANGE—One type B crystal detector in good condition, \$2.25; 100 ampere, 600 volt Lightning Switch, parts, less base, \$1.50. Wanted; Blitzen or Murdock 43 plate rotary variable condenser. W. A. Meyer, L382 N. 13th St., Sheboygan, Wis.

WANTED—Clapp-Eastham Blitzen receiving transformer and variable condenser. Price must be reasonable. Murdock detector for sale or trade. H. D. Mattox, 260 West 11th St., Pomona, Calif.

FOR SALE—Two new DeForest Audions, no renewals necessary. Wanted a burnt out Audion. Quote lowest price. Wm. P. Earle, Jr., Box 375, White Plains, N. Y.

FOR SALE OR EXCHANGE — "Dazzler" bicycle gas lamp, \$1.00; also one second hand "Solar" gas lamp in good condition. Will sell cheap. Wanted: good rotary variable condenser at a reasonable price. E. H. Snider, 20 Normandy Ave., Rochester, N. Y.

FOR SALE—1 K. W. rotary, \$15.00. All communications answered. Harold Burhop, 1945 N. 7th St., Sheboygan, Wis.

FOR SALE—Complete Blitzen receiving set in good condition, or parts of same. Will sell cheap. C. G. Fuss, Little Valley, N. Y.

BARGAINS — One Bulldog 1" spark coil without vibrator, \$2.00; one commercial \$5.00 key, \$1.00; one $\frac{3}{4}$ K. W. Thordorson transformer (cost \$18.00), \$9.50. Must sell quick. W. J. King, 462 Pine St., New Orleans, La.

EXCHANGE — 1 K. W. Clapp-Eastham transformer for $\frac{1}{2}$ K. W. Thordarson with variable condenser to boot. Write me your wants. King Sam, 17 N. Elm St., Waterbury, Conn.

FOR SALE—Clapp-Eastham half K. W. Hightone set complete with continuous primary adjustment, \$75. C. E. Type D Commercial Tuner, mahogany case with mounted loading coil, cost \$100, \$70. Blitzen Receiving Set with self-contained detector, \$18. 1 Vilroplex key, \$7. 1 Highgrade Omnigraph, \$15, all in new condition. F. Underwood, Room 437 49 Westminster Street, Providence, R. I.

FOR SALE OR EXCHANGE: All kinds of wireless apparatus, including 80 watt dynamo, one to one transformer for audion amplifier, audion attachments, etc. Am in need of head-set, loose-coupler, variables, etc. Write me what you want or need. J. W. Holligan, 328 East 19th St., New York, N. Y.

FOR SALE—The best text book of wireless telegraphy. Written by Dr. Zenneck. The book is noted for its wonderful illustrations and is an authority on the subject. The Officers of the League can recommend no better book. Price \$4.00. The Secretary AMERICAN RADIO RELAY LEAGUE, Hartford, Conn.

FOR SALE OR EXCHANGE: Harley Davison 5 h.p. motor cycle engine in perfect condition, new 2A Browne Camera, \$15 New Mirrorscope for gas; K. D. battery motor cost \$5.00 will sell for \$3.00. Sydney Rosenthal 116 E. Tupper St., Buffalo, N. Y.

FOR SALE: 3 Galena detectors 30c. each; Brandes superior phones, \$3.50; two 4-volt motors 50c. each; 1 automatic telegraph teacher with tape, 50c.; Murdock 1500 ohm phones brand new, super-sensitive, \$3.50; two extra heavy wireless keys, \$1.60 each; Mesco fixed condenser, 40c.; $\frac{1}{2}$ Kw. spark gap, 75c.; postage on all, extra. Clinton B. Stanley, 153 Mariner St., Buffalo, N. Y.

WANTED: Articles, photographs, anything that interests the amateurs. For "QST." The Editors, AMERICAN RADIO RELAY LEAGUE, Hartford, Conn.

FOR EXCHANGE: Each month, a brand new number, of a brand new wireless magazine, filled with brand new articles, on brand new subjects. Will exchange twelve numbers of this brand new wireless magazine, "QST," for one dollar. Address, Secretary, AMERICAN RADIO RELAY LEAGUE, Hartford, Conn.

WANTED: Subscription agents for "QST." Help yourself, help the LEAGUE, help everybody. Address, AMERICAN RADIO RELAY LEAGUE, Circulation Agent, Hartford, Conn.

FOR SALE—One pair 1000 ohm Murdock phones; parts of Murdock \$8.00 variable slide plate condenser; \$6.00 Radio Equipment Co. loose coupler (new); $\frac{1}{2}$ " spark coil; one cat-whisker detector; also a Morse key. Will sell separately to the highest bidder or will exchange. William Wunder, 5801 Germantown Ave., Philadelphia, Pa.

FOR SALE: Halcum Rotary Spark Gap, cost \$12.00, will sell for \$10.00. Geo. W. Bonson, 287 East St., Dubuque, Ia.

General Notice!

to the
Licensed Amateurs of the U. S.

HEADQUARTERS:

Hartford, Conn., Jan. 24th, 1916.

On the first of December, the League membership numbered 635. On the tenth of January, it numbered 961. This indicates the favorable attitude of the amateurs of the country toward an operating organization for relay work and for the mutual distribution of information. If this interest continues to grow, we can count upon being able to number ourselves among the strong organizations of the country.

The amateurs of the country by this time are probably confident that the officers in charge of the American Radio Relay League are sincere in their efforts to make the transmitting of long distance amateur messages by relay a success, and that there is no money making scheme connected with the matter in any way. Hundreds of letters received since "QST" has been published indicate this very clearly. Unfortunately, however, it requires money in addition to hard work in order to answer the large correspondence from a membership of nearly one thousand and as many more amateurs who are not in the League, but want to enter. This money can only be obtained through voluntary subscriptions, of which there have been several, and the sale of STATION APPOINTMENT CERTIFICATES, LIST OF STATIONS BOOK, and QST MAGAZINE. We have no other source of income, and the success of our organization depends upon all of us coming forward and buying these three things. Every amateur should understand this, and do his share, both by ordering himself and also exerting his influence to see that his friends who are interested in wireless do the same.

It is not as though the three things ordered are not necessary. They are not to be compared with a pennant or a button or a pin. Every one of them is a help toward improving a station and assisting in carrying on relay work. The STATION APPOINTMENT CERTIFICATE insures an orderly and systematic appointment method whereby relay stations are indicated. The LIST OF STATIONS BOOK shows the call letters, location, and all the details regarding every other relay station in the country. "QST" keeps every one informed on successful amateur station operating. These three things, therefore, constitute three honest and legitimate necessities, and the officers have worked hard to produce them. Now that they are produced, and the hardest part of the work done, we only have to support them in order to make our scheme a success.

TO MAKE IT EASY, coupons of four different combinations have been printed and every amateur is urged to send in one of them properly filled in, and not delay doing it.

THE AMERICAN RADIO RELAY LEAGUE, INC.

COUPON PAGE

These coupons are meant to make it easy for you to do your share. REMEMBER--To keep this League going every one of us must do his bit

AMERICAN RADIO RELAY LEAGUE,
Hartford, Conn.
Gentlemen:

Enclosed please find \$2.00 for which kindly send me my Certificate of Appointment, the 1915 List of Stations book, one pad of message blanks, and "QST" for one year.

Name

Street

City and State

(cut off here)

AMERICAN RADIO RELAY LEAGUE,
Hartford, Conn.
Gentlemen:

Enclosed please find \$.50 for which send me by return mail the List of Stations book and a three months trial subscription to "QST."

Name

Street

City and State

(cut off here)

AMERICAN RADIO RELAY LEAGUE,
Hartford, Conn.
Gentlemen:

Kindly enter my name for a year's subscription to "QST"; I am enclosing \$1.00

Name

Street

City and State

(cut off here)

AMERICAN RADIO RELAY LEAGUE,
Hartford, Conn.
Gentlemen:

I am enclosing \$5 for which kindly send me by return mail Zenneck's Wireless Telegraphy, and enter my name for a year's subscription to "QST."

Name

Street

City and State

Amplifying Receivers

MICA DIAPHRAGMS



¶ Over a year ago we introduced the wonderful Amplifying Receivers. They are tested and tried.

¶ We guarantee you will hear stations unheard on receivers of the regular type. Every A. R. R. L. member should have a pair of Amplifying Receivers if he wants to work over maximum distance.

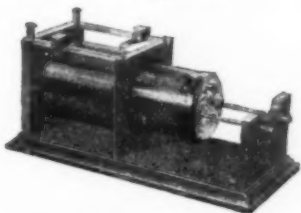
**Special Price, \$24.00 Per Pair
Complete**

F. O. B., Philadelphia, Pa.

Radio Apparatus Co. of America

**PHILADELPHIA, PENNSYLVANIA
PARKWAY BUILDING**

Our Standard Loose Coupler



The greatest thing out. 7 in. high, 7 in. wide, 15 in. over all. Wound with Enameled wire (secondary with silk, if desired), has double slide and eight taps, with heavy rheostat handle. Woodwork mahogany finished. Price, \$7.00. Also have a new one, 6 in. high, 6 in. wide, 14 in. over all, wound with same wire, but with single slide. Only \$4.50.

F. B. CHAMBERS & CO.
2046 Arch Street
Philadelphia, Pa.

"Mignon - System"

The Last Word in Radio Signal Receiving
Apparatus for Commercial and
Amateur Use



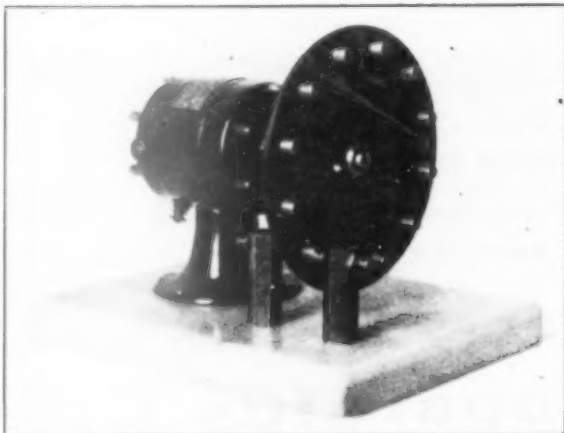
Unapproached Selectivity
Sensitiveness and Durability

WRITE FOR CATALOG

Dept. A
Mignon Wireless Corp.
Specialists in
Radio Receiving Apparatus
Elmira - N. Y.

ALWAYS MENTION "QST" WHEN WRITING TO ADVERTISERS

Klitzen Apparatus means Efficiency



**Klitzen Rotary
complete**

\$12.00

Marble base, Bakelite Disc,
Universal Motor, operates
on 110-130 volts AC-DC.
25-60 cycles. 6000 r.p.m.

Motor only, \$6.50

Disc complete, \$2.50

Klitzen Wireless Apparatus Company

1123 Herrick Avenue, Racine, Wisconsin

Radio Telegraph and Telephone Engineering

A LARGE CATALOG on Radio Telephone and Telegraph Instruments; Steel Towers and Masts; High and Low Frequency Motor-Generators; Rotary Converters; Switch-boards and Parts; High Tension Insulators; Storage Batteries and a complete line of Radio Construction Material: now ready for distribution. Please remit ten cents to cover postage. Our specially designed and manufactured apparatus is giving a high state of satisfaction throughout the country, as we have eminent radio engineers in our service. We solicit your inquiries for information or quotations.

Stations, Antennae, Instruments Designed and Constructed

**Eastern Scientific Apparatus Co.
West Roxbury, Boston, Mass.**

ALWAYS MENTION "QST" WHEN WRITING TO ADVERTISERS



"I received messages from San Francisco—2100 miles—
WITH CRYSTALOI

July 9th, while at anchor in Kahului Harbor Hawaiian Islands. I copied K P H San Francisco Press with Crystalloi, at a distance of 2100 miles." (Signed,) A. H. Randow, Operator, S. S. Dakotan.



CRYSTALLOI

The highly sensitive, permanent

WIRELESS DETECTOR

is making new records like this every day

THREE TYPES

- TYPE 0—Dimensions $2\frac{1}{4} \times 1\frac{1}{8}$ inches Mailing Weight, 1 lb. PRICE, \$3.50
 TYPE AA—Dimensions $4 \times 3\frac{1}{2}$ inches Equipped with cohering inductance. Mailing Weight, 2 lbs. PRICE, \$6.00
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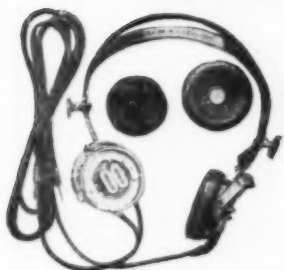
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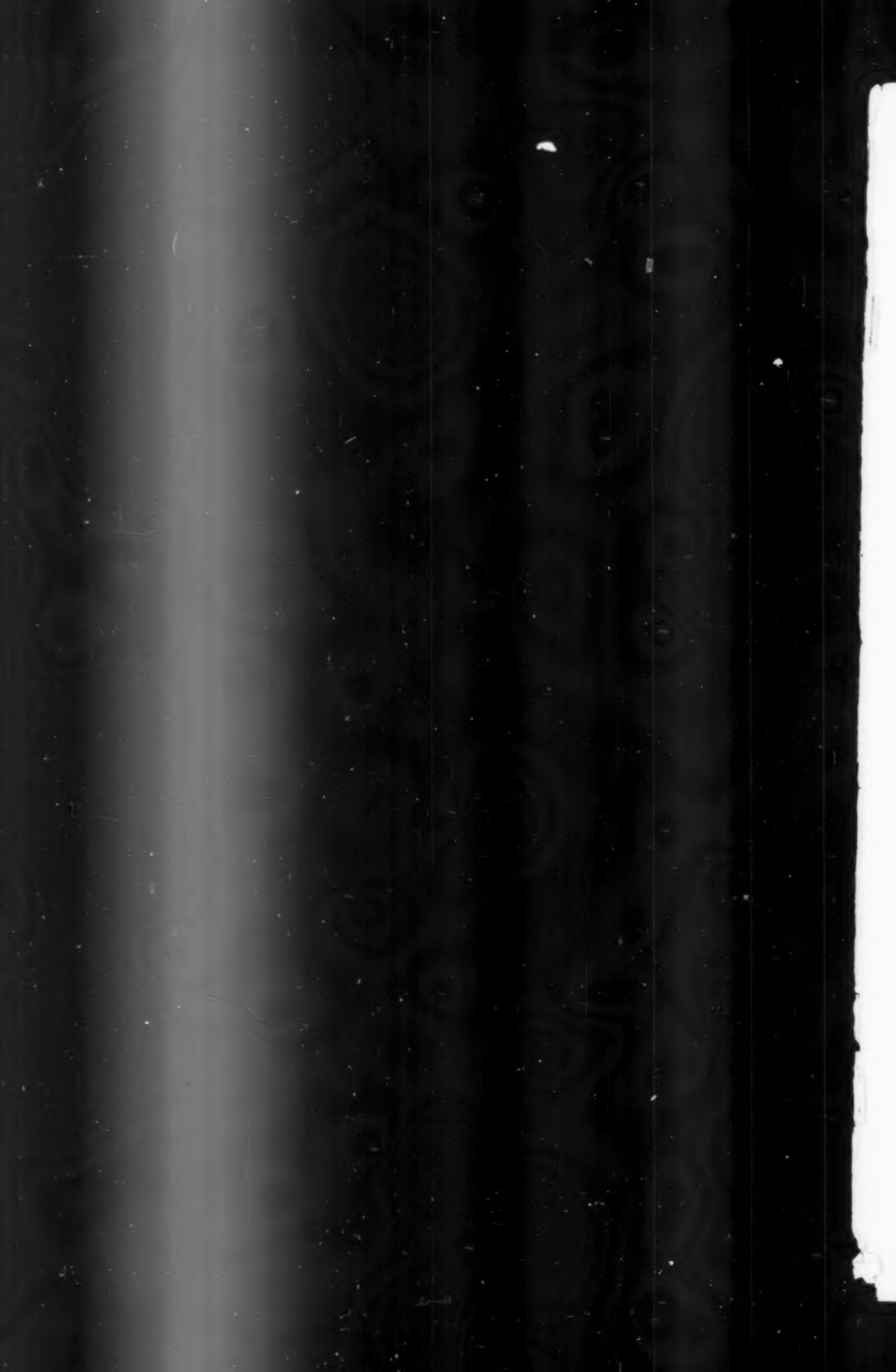
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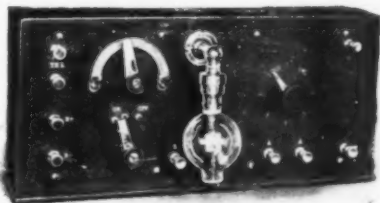
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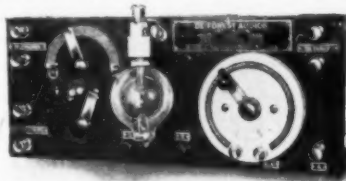
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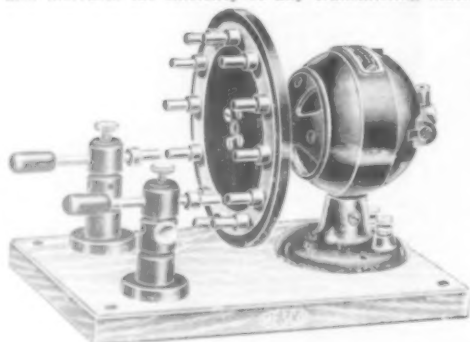
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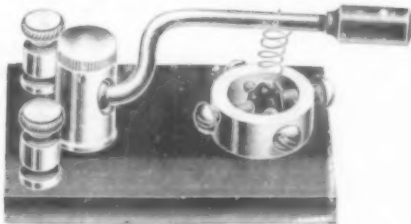
A hollow standard encloses a brass ball. Through an opening in the wall, a brass arm with hard rubber handle is secured fast to the ball, making a ball and socket joint, allowing it to be adjusted at any angle or used in any position.

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